**Section D: Extending Your Comprehension**  
*(Answers below)*

27. Suppose that in an ANOVA the groups are all identical (that is, $X_{ij} = X_{ij}$ for all $i$, $j$, and $J$). What value does $F$ have?

28. Suppose that in an ANOVA all the members of group 1 have value 1 (that is, $X_{1i} = 1$ for all $i$), all the members of group 2 have value 2, all the members of group 3 have value 3, and all the members of group 4 have value 4. What value does $F$ have?

29. Suppose that in an ANOVA with four groups, all the members of every group have value 2 (that is, $X_{ij} = 2$ for all $i$ and $j$). What value does $F$ have?

30. Create a data set with four groups, four members in each group, such that $F = 1.0$.

**Section E: From the Journals**  
*(Answers below)*

31. Hall and Honey (1990) investigated “the conditions that influence the transfer of a conditioned emotional response from one context to another” (p. 271). In particular, they predicted that “conditioned responding should be less vigorous when those contextual cues that were present during acquisition are absent at the time of testing.” They divided 32 rats into four groups that were to acquire the behavior of pressing a flap to gain access to food pellets. The experimenters created two kinds of salient contextual cues by introducing distinctive odors (either eucalyptus oil or iso-amyl acetate) or distinctive visual scenes (with or without black-and-white checkered wallpaper on the sides of the operant chambers). Their basic design was to have each of the four groups of rats acquire the behaviors in one of these four contexts (eucalyptus oil/checkered wallpaper, eucalyptus oil/plain wallpaper, iso-amyl acetate/checkered wallpaper, and iso-amyl acetate/plain wallpaper) and then subsequently to test the behaviors in identical or different contexts. The details of this subsequent testing need not concern us at the moment.

Even though Hall and Honey randomly assigned the rats to the four groups, it was possible that the groups differed before training began. In order to rule out this hypothesis, the researchers measured the response rates of the four groups before they presented any of the contextual stimuli; the mean rates of response for the four groups were $\bar{X} = 27.62, 26.00, 20.28,$ and $20.25$ responses per minute. If these means were significantly different from one another, then any subsequent finding could be the result of initial differences between the groups, not the result of experimental manipulation.

Hall and Honey concluded that in this preliminary test, “an . . . ANOVA conducted on . . . the rates of response . . . showed that these rates did not differ, $F(3, 27) = 1.76, p > .17$” (p. 274).

(a) Are Hall and Honey’s degrees of freedom computed correctly?

(b) Is enough information presented to allow you to verify that $F$ was computed correctly? If so, verify the computation of $F$.

(c) Assuming equal group sizes (which was apparently not actually the case in Hall and Honey’s study, although they don’t say what the actual group sizes were), what was $MS_b$?

(d) Assuming that $F$ was computed correctly, approximately what was $MS_w$?

(e) Create a complete ANOVA summary table for this test.

(f) State the conclusion of this test in plain English.
32. **(Exercise 31 continued)** Suppose we replicate Hall and Honey’s (1990) study and, like them, seek to know whether the four groups of rats have significantly different response rates before training begins. We use 24 rats, assigning six to each group. The response rates (responses per minute) are shown in the table.

(a) How many degrees of freedom are there for our test?

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.1</td>
<td>22.0</td>
<td>27.2</td>
<td>28.5</td>
</tr>
<tr>
<td>30.1</td>
<td>22.6</td>
<td>21.6</td>
<td>23.5</td>
</tr>
<tr>
<td>28.6</td>
<td>26.0</td>
<td>21.7</td>
<td>36.2</td>
</tr>
<tr>
<td>25.4</td>
<td>11.1</td>
<td>27.1</td>
<td>19.2</td>
</tr>
<tr>
<td>23.6</td>
<td>26.0</td>
<td>18.5</td>
<td>24.7</td>
</tr>
<tr>
<td>27.3</td>
<td>20.8</td>
<td>26.3</td>
<td>15.4</td>
</tr>
</tbody>
</table>

(b) Compute the analysis of variance, showing the complete ANOVA summary table.

(c) State your conclusion in plain English.

**Section F: Computer Explorations**

33. Ask the computer to perform an ANOVA on the following data:

*Sample 1:* 1, 1, 1, 1, 1
*Sample 2:* 2, 2, 2, 2, 2
*Sample 3:* 3, 3, 3, 3, 3

(a) Explain why the computer tells you that the ANOVA F is undefined for these data.

(b) Change the last point in sample 3 from “3” to “3.01” Now what happens to F? Explain why.

(c) Recall that in Exercise 31 in Resource 11X, you performed an independent-sample t test for similar data. Explain the similarities in your results.

34. (a) Have the computer create a random sample of size five from the population of IQ scores \( \mu = 100, \sigma = 15 \). *[Hint: We described how to do that in Section 7.3.]*

(b) Have the computer create a second random sample of size five from the population of IQ scores \( \mu = 100, \sigma = 15 \).

(c) Have the computer create a third random sample of size five from the population of IQ scores \( \mu = 100, \sigma = 15 \).

(d) If these are the data in a three-group ANOVA, what can you say about the truth of the null hypothesis?

(e) Approximately what would you predict the ANOVA \( F \) to be?

(f) Why is it reasonable to predict that \( MS_w \) will be approximately \( (15)^2 = 225 \)? Why is it reasonable to predict that \( MS_B \) will also be approximately 225?

(g) Have the computer determine the ANOVA. How does the actual ANOVA summary compare with your predictions in parts (e) and (f)? *[Hint: You may be a bit surprised here.]*

35. Repeat Exercise 34 several times to get a feel for the magnitude of \( F \) when the null hypothesis is true, and for how far the two mean squares can vary from 225. Then try varying the sample sizes (try \( n = 200 \)). the number of groups, and other factors to extend your comprehension.
Answers to Selected Additional Exercises for Chapter 14

Section D: Extending Your Comprehension

27. .0

28. ∞

29. 0/0, undefined

Section E: From the Journals

31. (a) No; there should be 3 and 28 degrees of freedom.
(b) No
(c) Assuming equal $n_j$’s, $M_{S_B} = 117.73$.
(d) $M_{S_W} = 66.89$

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>353.19</td>
<td>3</td>
<td>117.73</td>
<td>1.76</td>
</tr>
<tr>
<td>Within</td>
<td>1872.92</td>
<td>28</td>
<td>66.89</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2226.11</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(f) We cannot conclude that the four groups have different means to begin with.

32. (a) 3 and 20

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>66.82</td>
<td>3</td>
<td>22.273</td>
<td>.83</td>
</tr>
<tr>
<td>Within</td>
<td>536.76</td>
<td>20</td>
<td>26.838</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>603.58</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(c) There is no significant difference in mean response rates between these groups.